

D. ROBERTS & C. JAMES.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED SEPT. 16, 1907

937,181.

Patented Oct. 19, 1909.

2 SHEETS—SHEET 1.

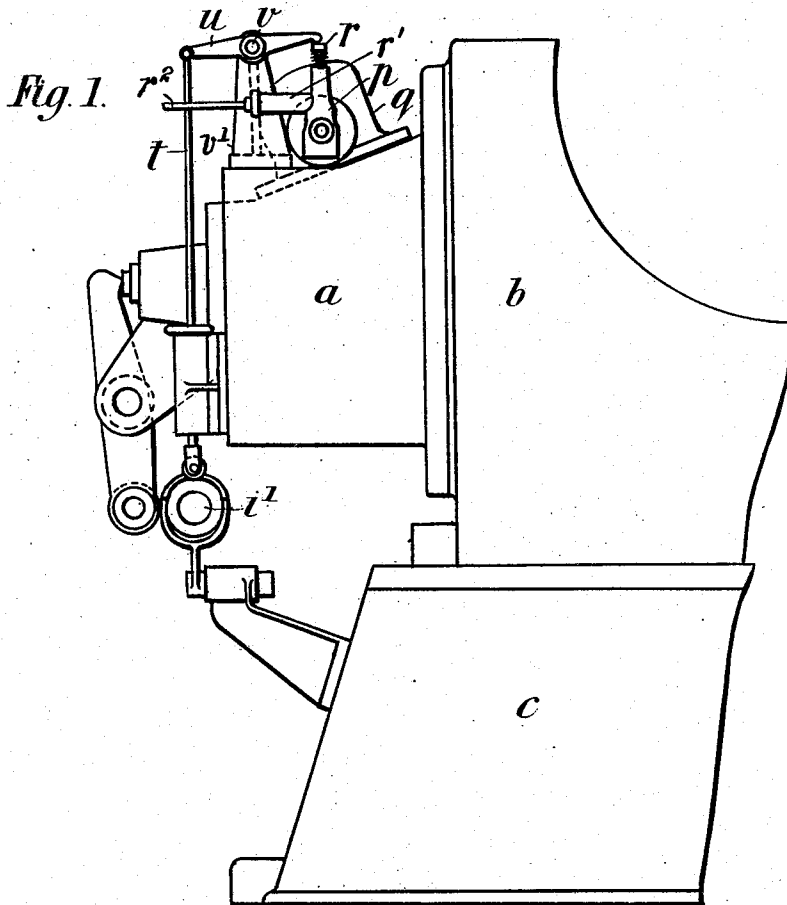


Fig. 5.



Fig. 7.

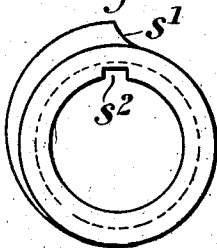


Fig. 8.

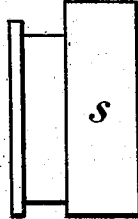


Fig. 10.

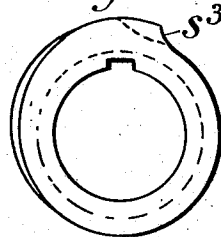


Fig. 6.

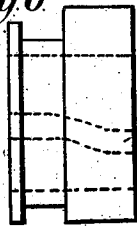


Fig. 9.



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2 SHEETS—SHEET 2.

Fig. 2

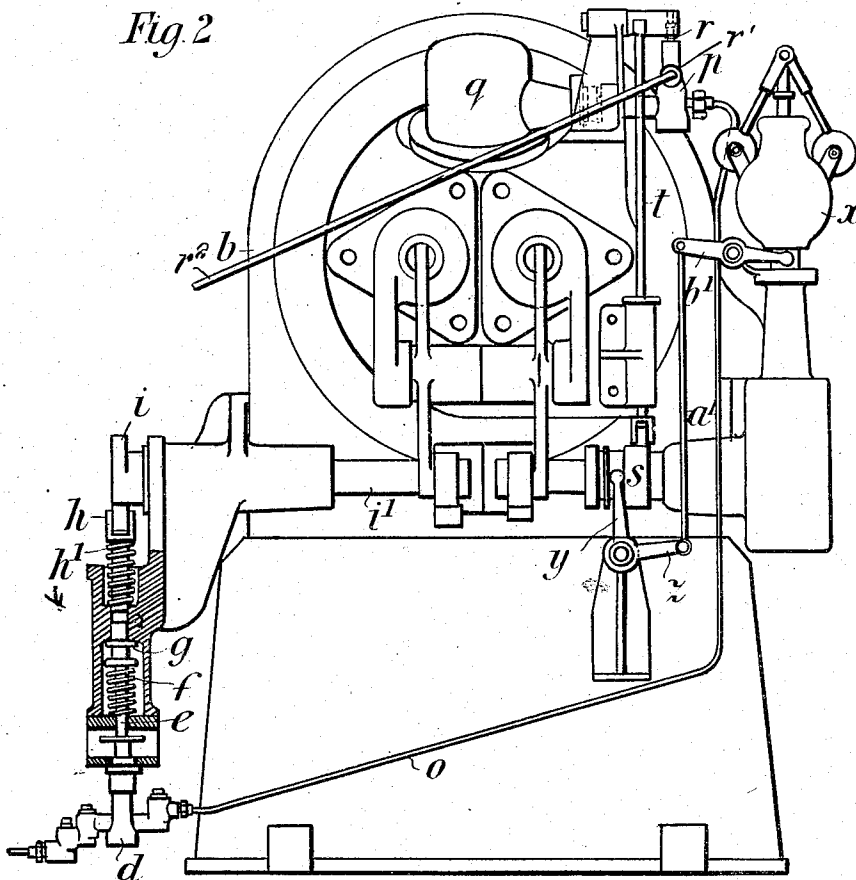


Fig. 3

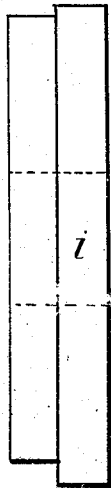
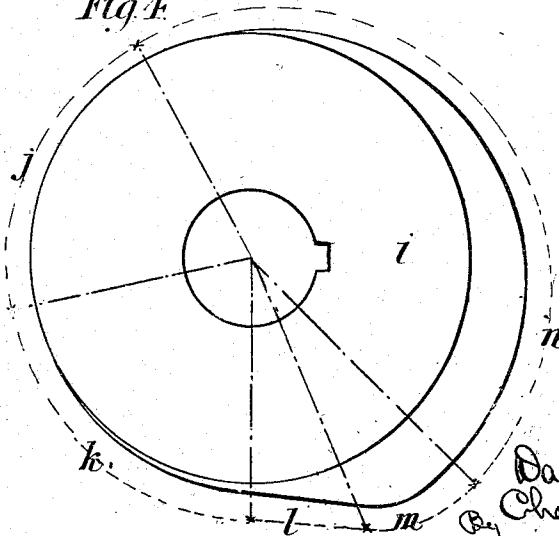


Fig. 4



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UNITED STATES PATENT OFFICE.

DAVID ROBERTS AND CHARLES JAMES, OF GRANTHAM, ENGLAND.

INTERNAL-COMBUSTION ENGINE.

937,181.

Specification of Letters Patent.

Patented Oct. 19, 1909.

Application filed September 16, 1907. Serial No. 393,039.

To all whom it may concern:

Be it known that we, DAVID ROBERTS and CHARLES JAMES, subjects of the King of Great Britain, both residing at Spittlegate Iron Works, Grantham, Lincolnshire, England, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

Our invention relates to internal combustion engines of the kind wherein liquid hydrocarbon is injected into a compressed charge of air at or near the end of the compression stroke with sufficient velocity to pulverize the hydrocarbon and chiefly to the class of engine described in the specification of former British Patent No. 4589/06.

The object of our invention is to provide improved means for operating the oil pump and governing the engine by controlling the oil supply so as to improve the efficiency of the engine.

In such engines as heretofore made the oil or hydrocarbon is injected through an oil nozzle by means of a pump the plunger of which is operated by a cam which actuates a striker. The cam is of such a form that the striker gives a sudden blow to the top of the pump plunger so as to eject the oil suddenly in a manner somewhat resembling that in which a projectile leaves a gun. The suction stroke of the pump is effected by a spring which lifts the plunger into contact with an adjustable stop the position of such stop being regulated so as to adjust the length of stroke of the pump. It has been found in practice that such a construction of engine is noisy in operation and also that the mode of regulation of the pump stroke is unsatisfactory owing to its varying the time at which the oil is injected into the cylinder. Furthermore in such engines the governing has been effected by acting directly upon and opening the vertical or relief valve in the vaporizer valve box cutting out the oil supply, and this has also been found to be unsatisfactory particularly in the case of multi-cylinder engines.

Now, our invention has for its object to overcome the defects above mentioned and to this end we operate the striker for actuating the pump plunger by means of a cam similar to that described and shown in the specification of the above mentioned former British patent but having on its periphery five faces or curves. The first face or por-

tion of the periphery is concentric with the driving shaft upon which the cam is mounted and which may be termed a "rest"; the second face is a snail-shaped or spiral rising grade of low pitch the distance from the center to its periphery increasing gradually, from the "rest" and has for its object to bring the striker gently into contact with the top of the pump plunger; the third face or grade is the delivery face or grade and is shaped to give a rapid action on the delivery or effective stroke of the pump and the fourth face is a grade forming an extension of the third face and passes by a convex face of easy shape into the fifth face which is a snail-shaped grade, gradually decreasing in radius toward the "rest". The object of the fourth face is to provide a greater length of stroke to the pump plunger than the delivery or effective stroke so as to allow of its being brought gradually to rest after it has completed the delivery stroke; owing to the easy lead of this face of the cam the roller of the striker follows it and thus destroys the noise and shock which would otherwise be caused on its leaving the cam face. In some cases we may make the cam with four faces or curves only and this is effected by omitting that face which we have above referred to as the first face or rest and lengthening the second and fifth faces. Furthermore, to govern the engine we control the oil supply by mechanically operating the vertical valve in the vaporizer valve box by means of a cam driven from any suitable part of the engine, preferably the main cam shaft. The said cam is carried on a spiral key upon the driving shaft and is adapted to be moved lengthwise by the governor which partially rotates it in so doing, thus bringing the operative face into action either earlier or later according to the load on the engine. The result is that the relief or vertical valve in the vaporizer valve box is opened either earlier or later according to the load on the engine. When the relief valve is opened the oil from the pump is cut off from the vaporizer and caused to flow through a by-pass back into the tank. It will thus be seen that the quantity of oil introduced into the vaporizer varies with the load. The vertical valve in the vaporizer valve box is operated from the cam by any well-known means such, for example as lever and rod mechanism.

In some cases, in lieu of employing a cam

sliding upon a spiral key as above described, we may employ a plain key and form the face of the cam spiral in shape, the operation being otherwise the same as that above described.

To enable our invention to be fully understood we will describe it by reference to the accompanying drawings, in which:—

Figure 1 is a part side elevation of an engine having the improvements applied thereto. Fig. 2 is an end elevation of the same. Figs. 3 and 4 illustrate in side and end elevation respectively and to a larger scale the cam which operates the striker for actuating the pump plunger. Figs. 5, 6 and 7 are respectively a side elevation, plan and end view of the cam for operating the vertical valve in the vaporizer valve-box and Figs. 8, 9 and 10 are similar views illustrating a modification of the same.

a is the cylinder of the engine; b the main frame and c the bed-plate thereof.

d is the oil fuel pump, e the plunger thereof and f the spring which operates the said plunger e on the up or suction stroke.

g is the stop which limits the travel of the plunger e on the up or suction stroke and h is the striker which is held by a spring h^1 against the face of the operating cam i shown detached in Figs. 3 and 4. This cam as above described has five faces j, k, l, m, n . The first face or rest j is concentric with the driving shaft i^1 on which it is mounted to allow the pump plunger e to remain at rest during a portion of the revolution of the cam so as to give the valve time to seat itself at the end of the suction stroke. The second face or grade k is snail-shaped so as to bring the striker h gently into contact with the pump plunger e . The third face or grade l is the delivery face or grade and operates the pump on the effective or forcing stroke. The fourth face or grade m which is an extension of the third face or grade l , passes into the fifth face or grade n which is snail-shaped and causes the suction stroke to be performed slowly. The first portion of the fourth face or grade m being a continuation of the third face l , its effect is to prolong the working stroke which is quickly started by grade l and to stop the working stroke gradually by bringing the plunger gradually to rest as the second portion of the fourth face m is brought into action.

o (Fig. 2) is the delivery pipe by which the oil is conveyed from the pump d to the vaporizer valve-box p through which it is injected into the vaporizer q ; r is the vertical or relief valve in the vaporizer valve-box p which is operated by the face s^1 of the cam s through the medium of the rod t and the lever u , the latter of which is fulcrumed at the point v to the bracket v^1 .

r^1 is the bypass from which a pipe r^2 leads to the oil tank to return thereto any oil

pumped through pipe o , after the relief valve r is operated.

The cam s is mounted upon the shaft i^1 to which it is secured by means of a key fitting in the spiral key-way s^2 , shown in Figs. 6 and 7. The said cam s is adapted to be moved lengthwise along the shaft i^1 and thus turned relatively with the same by means of the variation in the position of the governor as the speed of the engine fluctuates; this is effected through the medium of the lever and link mechanism y, z, a^1, b^1 .

In Figs. 8, 9 and 10 we have shown a modified construction of the cam s in which the said cam slides on a key parallel to the shaft i^1 and is provided with a spiral or inclined operating face s^3 .

It will be understood that in lieu of mounting both the cams upon the same shaft we may mount them upon different shafts and also that we may vary the mode of conveying the motion of the cam s to the vertical or relief valve r in any desired manner and, furthermore, that the invention although shown applied to a single cylinder engine is also applicable to multi-cylinder engines.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In an internal combustion engine, the combination with the cylinder, of a pump for supplying liquid hydrocarbon thereto and a cam for operating the pump plunger, provided with a gradually rising grade, a grade of steeper pitch to effect a quick working stroke of the plunger, and a long falling grade, for restoring the parts to normal position without shock, substantially as described.

2. In an internal combustion engine, the combination with the cylinder, of a pump for supplying liquid hydrocarbon thereto, a striker for operating the pump plunger and a cam engaging the striker and provided with a slow rising grade for bringing the striker gently into contact with the pump plunger, a steep rising grade for effecting a quick working stroke of the plunger and a slow falling grade for returning the plunger and striker to normal position without shock; substantially as described.

3. In an internal combustion engine, the combination with the cylinder, of a pump for supplying liquid hydrocarbon thereto, a striker for operating the pump plunger, a spring for actuating the plunger during the suction stroke, and a cam engaging the striker for actuating the plunger during the working stroke, said cam having a slow rising grade, for bringing the striker gently into contact with the plunger, a steep rising grade for effecting a quick working stroke of the plunger, a slow falling grade, and a

convex face or grade connecting the quick rising grade and the said falling grade and having a part forming a continuation of the quick rising grade, substantially as described.

4. In an internal combustion engine, the combination with the cylinder, of a pump for supplying liquid hydrocarbon thereto, a striker for operating the pump plunger, and a cam engaging said striker, and provided with a rest, a low rising spiral grade for bringing the striker gently into contact with the pump plunger, a steep rising grade for effecting a quick working stroke of the plunger, a convex grade having a part forming a continuation of said steep grade, and a spiral falling grade for returning the parts to normal position without shock, substantially as described.

5. In an internal combustion engine, the combination with the cylinder, of a pump for supplying liquid hydrocarbon thereto, means for continuously operating said pump, a relief valve, for cutting off the supply of liquid to the cylinder, a by-pass for convey-

ing excess liquid from said relief valve, a cam for operating said relief valve and a governor operatively connected with said cam for advancing or retarding the time of operation of said relief valve, substantially as described.

6. In an internal combustion engine, the combination with the cylinder, of a pump for supplying liquid hydrocarbon thereto, means for continuously operating said pump, a relief valve, for cutting off the supply of liquid to the cylinder, a by-pass for conveying excess liquid from said relief valve, a cam for operating said relief valve, a shaft for said cam, said cam being movable longitudinally of the cam shaft, and a governor connected with said cam for moving it on its shaft, to retard or advance the time of operation of said relief valve, substantially as described.

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